Hemifield effects on the read-out of the visual analog

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1.Introduction

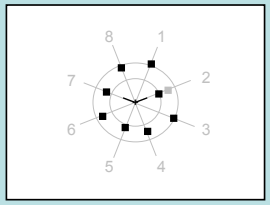
Background. The existence of visually detailed informational persistence (*visual analog*) has been documented both within fixations and across saccades (De Graef & Verfaillie, 2002). Because of the short-lived nature of the visual analog, the amount of information that can be read out from it is constrained by the time needed to focus attention on a specific location (Germeys et al., 2007). Combined with recent evidence for independent attentional resources in left and right hemifields (Alvarez & Cavanagh, 2004), this entails the possibility of hemifield effects in the read-out process. Using a spatial location change detection task where attention was directed in the interstimulus interval by cueing locations either within a hemifield or across hemifields, we assessed the presence of such hemifield effects.

Task. Subjects see a memory array of 8 small squares for 250 ms. The array is followed by a 500 ms blank containing either no cues or a 100 ms presentation of one central cue or two central cues. After the 500 ms blank, a single test square is presented and subjects have to decide whether its location has changed relative to where it was in the initial memory array.

Predictions.

1. Selective attentional read-out from the analog at the tested position:
   one cue > no cues
2. Full hemispheric independence:
   two different-hemifield cues = one cue > two same-hemifield cues
3. Partial hemispheric independence:
   one cue > two different-hemifield cues > two same-hemifield cues

2. Stimuli

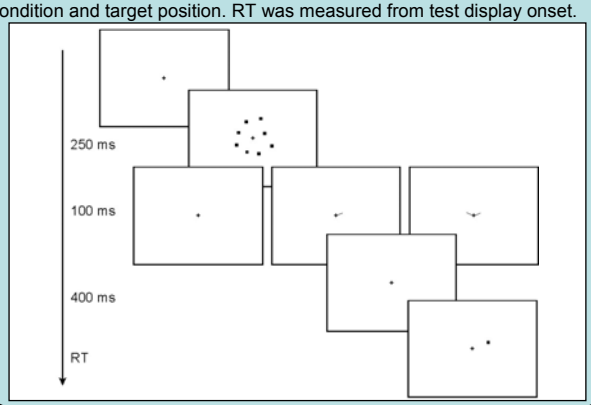


Superimposed memory, cue and test display. Gray circles, radials and digits not visible to subjects, gray square illustrates location change.

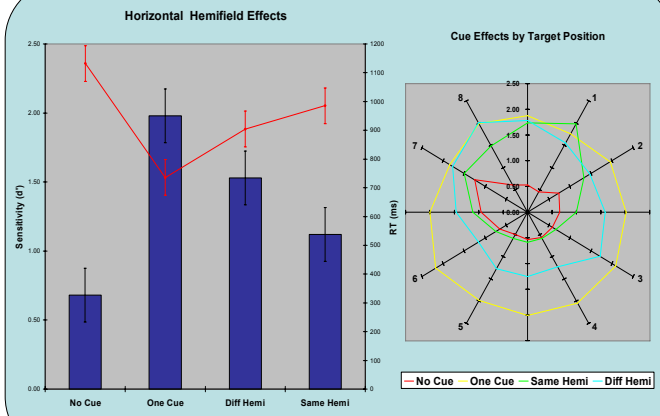
- Each memory array contains 8 squares of 0.75°, placed at 3°-5° eccentricity from a central fixation point. Each square is placed on a separate imaginary radial, radiating out from the central fixation cross at an angle of 22.5° relative to the vertical and horizontal meridians.
- The cue display presents one, two or no cues radiating out from a central fixation cross. Cues are 1.5° line segments aligned with the imaginary radials that hold the squares in the memory display. Each radial position (from 1 to 8) is cued equally often, either alone or accompanied by a second cue. The second cue points equally often to the 7 remaining radial positions, resulting in trials with same-hemifield cues and trials with different-hemifield cues.
- The test display shows one square from the memory array, either occupying its original position (50 % trials) or a new position 1° inwards or outwards along its radial (50 % trials).

3. Method

Procedure & Design. 6 subjects each saw 960 trials. Eye movements were recorded with an EyeLink I tracker at 250 Hz ensuring central fixation during presentation of the memory array. Hits and false alarms in the spatial change detection task were used to compute *d'* as a function of cue condition and target position. RT was measured from test display onset.



4. Results



5. Results ctd

Main results

1. Partial left-right hemifield independence revealed in speed and accuracy
2. Bi-directional performance symmetry when single cue
3. Vertical performance asymmetry when two cues are present
   - change detection lower-field targets more impaired by second cue
   - especially when 2nd cue in upper quadrant of same horizontal hemifield

6. Conclusions

- A 250 ms glimpse is sufficient to create a visual analog which reliably stores the location of at least 8 items scattered in all directions of the visual field
- A single cue allows attention to shift and efficiently retrieve location information from any direction in the rapidly decaying visual analog
- When multiple attentional targets are cued, attention can be divided more easily between than within horizontal hemifields
- When multiple attentional targets are cued, lower-field targets have a lower saliency than upper-field targets, particularly when they are located in the same horizontal hemifield

References

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